New

64 Doctor

TRILOGIC

64 DOCTOR - A PROFESSIONAL DIAGNOSTIC CARTRIDGE FOR YOUR C64.
Plug in the '64 DOCTOR, switch-on & you will quickly be able to see if there is a problem with your 64 & identify which of the major chips is faulty. TESTS:-

KEYBOARD	JOYSTICK PORT
SERIAL PORT	USER PORT
CARTRIDGE PORT	BASIC ROM
KERNAL ROM	CIA CHIPS
VIDEO CHIP & VIDEO BANKS	SOUND CHIP
NMI & IRQ INTERRUPTS	CASSETTE KEY PRESS
CASSETTE DATA	EVEN TESTS YOUR JOYSTICKS

HOW TO USE THESE INSTRUCTIONS.

Each test includes a list of possible faults. At the end of the section there is a list of common faults including some which cause the computer to be dead on power-up.

PART 1 — FINDING THE FAULT

1) THE TESTS.

FIRST STEPS:-

SWITCH OFF THE COMPUTER
INSERT THE CARTRIDGE & USER PORT & SERIAL PORT CONNECTORS.
SWITCH ON THE COMPUTER.

NB DISCONNECT THE DATASETTE WHEN USING THE SERIAL PORT TESTS

KEYBOARD TEST

The screen will display the keyboard layout - press each key in turn (omit the RESTORE key & shift lock), each functioning key will be highlighted on the screen.

FAULTS:

If one key is non-operational then dirty contacts are the likely cause.
If several keys do not work, then a faulty CIA chip (U1) is indicated.
If the RESTORE key has no effect then U20 is a likely cause.

JOYSTICK PORT TEST

Hit RESTORE to exit the keyboard test.
Connect a joystick to port 1 and move it through all the positions. The screen representation should mimic the operation of each switch in turn.
Repeat the test on port 2.

FAULTS:

If both ports show the same fault, suspect the joystick first.
Otherwise, a faulty CIA chip U1 is likely.
If an analogue joystick or paddle doesn't work, U18 or U28 may be faulty.
Finally, the connector may have worked loose on the circuit board & need resoldering.

MAIN CIRCUIT, USER & SERIAL PORT TEST.

Hit RESTORE to exit the joystick port test.
The screen will now display a list of the parts tested, the Commodore part No. & location on the circuit board and show up any faults that the 64 DOCTOR has detected.

2) COMMON FAULTS:

VIDEO CHIP U19. Graphics characters instead of letters.- very rare. Also check the character rom U6.

VIDEO BANK SWITCHING. The 64 Doctor switches continuously through all 4 video banks. The switching is controlled by U2 & U14 so if the characters are affected in one bank only then suspect these chips. If characters are affected in all banks, then suspect U2, U14, U19 & U17.
If coloured blocks appear instead of characters then suspect U26 & U17.
If bits of characters are missing in all banks suspect U5.
If abnormally coloured characters are present then suspect U6 & U16.

VIDEO INTERRUPTS. Rarely encountered - but if a game which uses split screen techniques doesn't run properly then U19 could be faulty.

USER PORT & SERIAL PORT. Faults here are usually due to malfunction of U1 or U2. Additionally, U8 if fault affects the serial port.

CIA TIMERS. There are two timers in each CIA (U1 & U2) Timer A of U1 is used to generate IRQ interrupts (see below). The remaining timers are available for use by software, although one timer of U2 is used during serial port data transfers - disk or printer.

CIA IRQ. If U1 is faulty & timer A is inoperable then, when the computer powers up, the cursor disappears immediately & key presses are ignored. Also worth checking are U2, U15, & U7.

CIA NMI. U2 can generate NMI interrupts, but these are not used except by external software. Some programs & cartridges such as the EXPERT may not work properly if U2 cannot produce NMIs. U20 & U8 should also be checked.

BASIC ROM. If the Basic rom U3 is faulty, on power up the screen & border are of the correct colour, but there are no characters displayed.

KERNAL ROM U4. If faulty then usually only a black screen on power up.

SOUND CHIP. There should be 3 different sounds one for each of the sound channels followed by a pause. The randon number generator is also tested. A faulty sound chip U18 can also affect tape loading, or give rise to various untoward noises from the tv speaker.

CASSETTE KEY PRESS. If the screen blanks immediately you press Shift & RUN/STOP then U7 is faulty. Probably caused by unplugging the datarecorder whilst the power is on.

CASSETTE DATA. Failure to load can be due to faulty U1. Failure to save can be due to faulty U7. Either fault can be caused by inserting/removing the datasette plug when the power is on.

COLOUR BAR. Wrong colours, weak colours or no colours. Usually corrected by adjusting the preset Y1 or R27 which controls the colour clock U31, which itself may be faulty. Check tv tuning too.

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3) OTHER FAULTS

SCREEN STAYS BLACK AFTER SWITCHING ON. Can be due to just about anything, but most likely are: -
POWER PACK - if led is on then power pack can still be faulty, or the internal power supply components VR1 & VR2 may be faulty.
RAM CHIP FAULT - leave the power on for a few minutes & feel each chip - there are 8 type 4164 ram chips - U9,10,11,12, 21,22,23,24 (on some versions there may be 4, type 4464 chips instead) any that are much hotter than the others are probably defective. TIP. Spray each chip in turn with freezer spray - the hottest ones show up much easier.
OTHER CAUSES: U7, U3, U4, U8, U17, U20.

NO PICTURE ON TV BUT PICTURE OKAY ON MONITOR. Suggests that the modulator is faulty or out of adjustment or the aerial lead is broken or the tv is tuned to the wrong channel.

LONG PROGRAMS DO NOT LOAD. U7 faulty.

SCREEN FULL OF FLASHING, COLOURED BLOCKS ON POWER UP. Usually U17, but may also be U26, U19 & U14.

ABNORMALLY COLOURED CHARACTERS. U6 or U16 may be faulty.

CASSETTE MOTOR DOES NOT STOP. Q3 the TIP29 transistor may be hot & the fuse may blow - short on the cassette port. If the transistor is not hot, then U7 is probably faulty.

DEVICE NOT PRESENT ERROR when loading from disk - check U1, & U7

DISK CONTINUES TO SEARCH - check U2.

SYNTAX ERROR when loading from cassette - check U20.

BLACK BAND SCROLLS THROUGH THE SCREEN OR WAVERING OF THE PICTURE. Power supply or VR2 5v regulator faulty.

POWER SUPPLY - BLACK SCREEN. The standard power pack is encapsulated in resin, overheats, & a dry joint on the voltage regulator causes the voltage to rise. Or the overheating can blow the regulator so the voltage drops to zero.

RAM CHIPS - BLACK SCREEN. If the 5v supply from the power pack rises by more than 5%, then the first to blow is one, or quite often, all of the ram chips. Otherwise, one or two chips may blow for no apparent reason, usually they then get too hot to touch so are not difficult to diagnose.

PLA (U17) - COLOURED FLASHING BLOCKS OVER THE ENTIRE SCREEN.

CIA U1 OR U2. KEYBOARD, TAPE LOADING, DISK SAVE/LOAD OR MISSING CURSOR, OCCASIONALLY CORRUPT SCREEN.

U7 - DATASETTE PROBLEMS - MOTOR DOESN'T STOP, SCREEN BLANKS WHEN SHIFT & RUN/STOP PRESSED, NO TAPE SAVE.

4) COMMON MECHANICAL & ELECTRICAL FAULTS

BAD CONNECTION ON THE ON/OFF SWITCH.
FAULTY SWITCH.
VIDEO, SERIAL & JOYSTICK PORT SOCKETS WORKED LOOSE.
DIRT IN THE KEYBOARD CONTACTS.
BENT CONTACT IN THE CARTRIDGE PORT CONNECTOR.
BLOWN INTERNAL FUSE.

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PART 2 - FIXING THE FAULT.

1) SWAPPING CHIPS.

CIA U1 & U2. These are the 6526 chips and as there are two of them, if you suspect one may be faulty, try swapping them. If the same fault persists then they are probably okay.

2) TESTING CHIPS ON ANOTHER COMPUTER

The simplest way to check the remaining chips is to borrow a friends computer. Hopefully, many of the chips will be installed in sockets in both yours & your friends computer, so it is simply a matter of using HIS computer (since you know it works) to check each chip in turn from your computer. Exchange one chip at a time, & if his computer continues to work then that chip is okay so return it to your computer straight away - BEFORE you try any of the others.

If your in luck, one of the socketed chips will prove to be the culprit, if not, then you will have to unsolder some of the remaining ones - but which ones ?

We can only suggest that you read through the faults described above & decide which seems the most likely chip. Also, feel each chip - any that are much hotter than average could be worth checking - this applies particularly to the ram chips.

3) 64 BOARD IDENTIFICATION.

There are at least 5 board layouts in existence, excluding the very recent 64C design which is actually physically smaller & uses fewer chips, not to mention some new Commodore custom chips & a combined Basic & Kernal rom.
On the front edge of the circuit board can usually be found the layout or assembly number:

326298-01 was the original design & has a 5pin video skt others have 8 pins.
250407-04 is version A & is the commonest .

250425 is version B - this has fewer components near U19
250441-01 is version B2 - this also has fewer components near U19
A fifth, recent version uses only 4 ram chips type 4464 instead of 8 type 4164 rams.

4) CHIP LOCATION

The location of each chip is specified by a U number which is printed on the upper side of the circuit board adjacent to each component. Please note - the number is specific to each chip type - not position. Thus on some boards, U17 & U18 may be transposed but the important point is that U18 is ALWAYS a 6581 (sound chip) & U17 is ALWAYS an 82S100 (PLA).

5) COMMODORE CUSTOM CHIP PART NUMBERS.

Many of the chips in the 64 are manufactured by Commodore and are not generally available from electronic distributors - this is a list of them. The other chips are widely available.

Please note, a 64 circuit diagram, plus much other helpful & informative details are contained within the 64 PROGRAMMERS REFERENCE GUIDE available from us for only £5.95 +.75p postage. (Normally £9.95 + postage)

DESCRIPTION	LOCATION NO.	CHIP NO.	PART NO.
CIA (complex interface adaptor)	U1 & U2	6526	906108-01
BASIC ROM	U3	2364	901226-01
KERNAL ROM	U4	2364	901227-01/2/3
CHARACTER ROM	U5	2332	901225-01
CPU (MICROPROCESSOR)	U7	6510	906107-01
PLA (PROGRAMMABLE LOGIC ARRAY)	U17	82S100	906114-01
SID CHIP (SOUND INTERFACE DEVICE)	U18	6581	906112-01
VIC CHIP (VIDEO CHIP)	U19	6569	906111-01
COMBINED OSCILLATOR CHIP	U31	8701	251227-02 *

*** U31 IS A 74LS629 ON THE ORIGINAL DESIGN & VERSION A.**

RAM CHIPS

The ram chips are made by several manufacturers - they are either 4864 or 4164 64k x 1 bit dynamic rams (8 off) or in later 64s, 41464 64K x 4 bit dynamic rams (2 off). The number is followed by -12, -15 or -20 this refers to the speed - do not use a replacement which has a higher number (lower speed) than the originals but higher speed - lower number devices can be used. Prefix letters only indicate the manufacturer & can be ignored - eg TMS = TEXAS, MK = MOSTEK, HM = HITACHI, MSM = OKI, uPD = NEC etc. Suffix letters eg NL, P, L or PL etc indicate power consumption & can also be ignored.

6) DESOLDERING CHIPS

IMPORTANT

THE CHIPS IN THE 64 ARE EASILY DAMAGED BY STATIC ELECTRICITY. DISCHARGE THIS BY TOUCHING AN EARTHED OBJECT BEFORE TOUCHING ANY CHIPS. Synthetic fibres in carpets & clothes are particularly bad for generating static so, to be on the safe side, run a wire from an earthed object such a water pipe or radiator or mains socket earth pin to your workbench & use it to discharge yourself. Although stsatic does not always produce instant damage, it can seriously reduce the working life of a chip or causae partial or intermittent breakdown.

BEFORE YOU START - have you read the warning above ?

For this you will need a 25 watt soldering iron with an 1/8" tip, 18 or 22 gauge solder, a solder sucker - the piston type is best, a small screwdriver, and a fair amount of care & patience, plus an Ic socket to replace the chip. Do NOT use an iron of less than 25w - they take too long to melt all the solder in the plated through holes.

The circuit board has plated through holes, plus very thin tracks & small solder pads which make chip removal a bit tricky. However, the technique is simple, at least in principle:-

Turn the circuit board over, identify the pins to be unsoldered, hold the solder sucker vertically above the ic pin & heat the solder until it melts. Do not apply to much pressure with the iron. Now quickly lower the sucker tip onto the molten solder surrounding the pin & release the plunger.

Hopefully, all of the solder will have been sucked out of the hole, - if not go onto the next pin - DO NOT make a second attempt on the same pin straightaway. When you've been round all the pins, now is the time to retry the failures.

Where your first attempts have failed, RESOLDER each pin in turn - this is neccessary because the heat from the iron will not reach down into the depths of the hole unless there is some solder to act as a conductor. All that will happen if you do otherwise is that the solder pad will become detached from the copper barrel of the hole & you will end up with a broken track.

Now, make a second attempt on each pin. If failure again stares back at you from the board, leave it & go on to the next one.

TO RECAP: make one attempt on each pin, then go on to the next one, resolder all the failures, repeat the sequence until all are done.

Assuming all the holes look reasonable free from solder - you may even be able to see daylight through them if you've done a good job - now is the moment of truth. Invert the board & try to lever the chip away from it with a screwdriver. It should come loose quite easily, although it is usually safe to apply a reasonable amount of force to the screwdriver. Often, you will find that the chip is held by one or two pins which need a bit more desoldering.

The next job is to check that you haven't broken any tracks - be particularly careful to scrutinise the top of the board which will be under the ic socket - you don't want to have to unsolder this too.

If all looks well, insert the ic socket - and solder it in place. Heat the pin & hole first & then apply the solder so that it is drawn into the hole. There should only just be enough solder to slightly overfill the hole - you've over done it if there is a mountainous blob around the pin.

7) REFITTING THE CHIP

Did you check which way the chip was fitted before you removed it ? Well, fortunately for you, on the 64, all the chips point towards the rear of the board - that is, the notch in the top end of the chip which indicates the pin 1 end should face the board rear edge.

8) DISASSEMBLING THE KEYBOARD.

Remove the top keyboard half of the case, turn it over & unplug the keyboard connector from the main circuit board. Next locate the 8 screws which hold the keyboard to the case & remove them. Place the keyboard on a flat surface & remove the 20 very small screws which hold the brown keyboard circuit board to the black keyboard chassis. Unsolder the two wires on the shift-lock & then carefully raise the circuit board to reveal the underside of the keys.

Now you will discover which of the two types of keyboard you have:-

Type 1 which is the early type & also fitted to the VIC20 consists of circular rubber 'springs' which fit into each key plunger. In the centre of each spring is a black conductive rubber pad which completes the circuit when pressed onto gold plated interleaved fingers etched onto the keyboard circuit board.

Type 2 - the commonest type, consists of a strip of conductive rubber attached to each key plunger which links two pads on the circuit board when the key is pressed. Each key has a metal return spring fitted under the key cap.

9) KEYBOARD REPAIRS.

As far as reapirs to the keyboard are concerned, there is not much that you do apart from cleaning the circuit board, & making sure all keys operated freely & that the rubber strips & buttons are intact, clean & fitted correctly.

The key caps are a push fit onto the plunger & can be pulled of without too much difficulty. However, it is more often the case that the key plunger is broken rather than the key cap.

As spares can be difficult to obtain, we recommend that you buy an old 64 or VIC 20 keyboard & either use it as it stands or for spares. (It will fit the 64 case.)

A final point worth checking - make sure none of the keyboard connecting wires are broken at either end, & that the connector on the main board is clean.

USEFUL TRILOGIC ACCESSORIES - SEE OUR PRICELIST FOR DETAILS.

25WATT SOLDERING IRON	SOLDER SUCKER
DIGITAL MULTIMETER	LOGIC PROBE
13 PIECE TOOL SET	64 REFERENCE GUIDE

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OTHER COMMODORE DOCTORS FROM TRILOGIC

DRIVE DOCTOR

This comprehensive disk drive diagnostic test kit comprises the DISK DOCTOR program on tape - so no matter what the problem with your drive, you will be able to install the DISK DOCTOR, plus a specially recorded alignment disk. Checks alignment, motor speed, backstop setting, head movement, and stepper motor hysteresis. Alignment is checked dynamically - a unique feature of the DISK DOCTOR. At only £14.99, it not only outperforms but is also cheaper than any similar products.

DATASETTE DOCTOR

This is a complete datarecorder service kit comprising wet type cleaner, demagnetiser, multifeature test program & alignment adjusting screwdriver. Reported as very good value for money in a recent review. ONLY £8.99

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